MODULATION OF SIGNALS FOR TRANSMISSION IN PACKETS VIA AN AIR INTERFACE

CROSS REFERENCE TO RELATED APPLICATIONS

This application is for entry into the U.S. national phase under §371 for International Application No. PCT/EP01/07863 having an international filing date of Jul. 9, 2001, and from which priority is claimed under all applicable sections of Title 35 of the United States Code including, but not limited to, Sections 120, 363 and 365(c).

FIELD OF THE INVENTION

The invention relates to a method for modulating signals in a device, which signals are to be transmitted by said device in packets via an air interface, each packet comprising at least one entity of at least two different entities, said at least two different entities being employed by said device for transmitting signals representing different kinds of information. The invention equally relates to a corresponding modulator and demodulator. The invention further relates to a device comprising such a modulator and/or such a demodulator and to a wireless communications network comprising at least a device with such a modulator.

BACKGROUND OF THE INVENTION

Transmitting modulated signals which are arranged in packets via the air interface is known for example for short-range radio links established between different devices. Short-range radio links can be employed for connecting devices located close to each other without requiring connections by cords.

Short-range radio links between electronic devices have been specified in the global "Specification of the Bluetooth system", v1.1, Feb. 22, 2001. The specification is aimed at providing a standard for low complexity low-cost wireless connections between portable and/or fixed devices, in particular devices which are located within a range of 10 meters to each other. An example for the employment of such a Bluetooth™ short-range radio link would be a wireless connection between a laptop or mobile phone and a printer.

Transmissions between devices as defined by Bluetooth™ are based on a frequency hopping system using 79 channels with 1 MHz each in the 2.45 GHz ISM (Industrial, Scientific and Medical) band. The data is transmitted in packets, and each packet is transmitted on a different hop frequency. In the specification, three different packet structure are defined. A first structure includes only an access code of 68 bits, a second structure includes an access code of 72 bits and a header entity of 54 bits, while a third structure includes an access code of 72 bits and a header entity of 54 bits and a payload entity ranging from zero to a maximum of 2745 bits. Each packet starts with the access code, which is used inter alia for synchronization purposes.

Any device can request a link to other devices, the requesting device being a master and the respective other devices being slaves. Connections can be point-to-point between one master and one slave, or point-to-multipoint between one master and several slaves sharing the same channel. A channel is defined by the hopping sequence used, whereas the hopping sequence is determined by the Bluetooth™ device address of the master. Two or more devices sharing the same channel form a piconet. All slaves in one piconet are synchronized to the system clock of the master. To this end, in a receiver of a slave a sliding correlator correlates against the access code of a received packet and triggers when a threshold is exceeded. This trigger signal is used to determine the receive timing.

According to the current Bluetooth™ specification, signals are modulated for transmission using a GFSK (Gaussian Frequency-Shift Keying) modulation scheme. More specifically, it is requested that a bit of '1' is represented by a positive frequency deviation from the transmit frequency, and that a bit of '0' is represented by a negative frequency deviation from the transmit frequency. It is further requested that the minimum absolute frequency deviation achieved by a bit sequence of '1010' is at least 80% of the absolute frequency deviation achieved by a bit sequence of '00001111'. With the requested modulation scheme, a gross data rate of 1 Mbit/s, corresponding to a symbol rate of 1 Ms/s, can be achieved.

It is a declared aim to at least double the currently specified medium data rate at low cost to a gross data rate of 2 Mbit/s or higher. It is important that a higher data rate system is fully backward compatible with the current specification, in order to ensure that current devices are also capable to operate as a slave in piconets that comprise higher data rate devices.

A further request for higher data rate devices relates to the synchronization of devices in a piconet. Since in the current piconets, the synchronization of a device can be based on the access code transmitted by the respective master in the first entity of each packet, it should be ensured that current devices can also decode the access code of transmissions employing a higher data rate. Preferably, a current Bluetooth™ device should also be able to decode the header of received packets, the header comprising e.g. an indication of the slave to which the packet is addressed, an indication of the type of the packet and thus an indication of the length of the packet.

Different proposals were made to increase the medium data rate for Bluetooth™ transmissions. In order to achieve a simple backward compatibility, all proposals are based on a modulation scheme similar to the scheme defined in the current specification for modulating access code and header. Only the payload is supposed to be modulated with a different modulation scheme enabling a higher data rate. Because of the different modulation schemes employed in all these proposals for access code and header on the one hand and payload on the other hand, the modulation scheme has to be changed between the modulation of the access code and the header and the modulation of the higher data rate payload. A change of the modulation scheme, however, requires a guard time between the modulation of the header and the payload. With some modulation schemes, even a new synchronization entity is required for symbol re-synchronization. Both, the guard time and a new synchronization, add complexity to the system and reduce the total achievable data rate.

In order to provide a comprehensive backward compatibility, a demodulator according to the invention should further comprise second demodulating means for demodulating other received signals which were modulated with a second modulation scheme. If this second modulation scheme is e.g. the GFSK modulation required by the current Bluetooth™ specification, the demodulator is able to demodulate signals modulated according to the invention and equally signals modulated by a current Bluetooth™ device.

In U.S. Pat. No. 5,706,428, it is proposed that the initial portion of a message is transmitted in a wireless data communication system at a first predetermined one of a first plurality of data rates and that the data portion of the message